

**Definitions  
(OPPOSITE, ADJACENT, HYPOTENUSE)**

$$\begin{aligned} \sin(\theta) &= \frac{\text{opp}}{\text{hyp}} & \csc(\theta) &= \frac{\text{hyp}}{\text{opp}} \\ \cos(\theta) &= \frac{\text{adj}}{\text{hyp}} & \sec(\theta) &= \frac{\text{hyp}}{\text{adj}} \\ \tan(\theta) &= \frac{\text{opp}}{\text{adj}} & \cot(\theta) &= \frac{\text{adj}}{\text{opp}} \end{aligned}$$

**Definitions - (x, y, r)**

$$\begin{aligned} \sin(\theta) &= \frac{y}{r} & \csc(\theta) &= \frac{r}{y} \\ \cos(\theta) &= \frac{x}{r} & \sec(\theta) &= \frac{r}{x} \\ \tan(\theta) &= \frac{y}{x} & \cot(\theta) &= \frac{x}{y} \end{aligned}$$

**Changing To Sine And Cosine**

$$\begin{aligned} \tan(\theta) &= \frac{\sin(\theta)}{\cos(\theta)} & \sec(\theta) &= \frac{1}{\cos(\theta)} \\ \cot(\theta) &= \frac{\cos(\theta)}{\sin(\theta)} & \csc(\theta) &= \frac{1}{\sin(\theta)} \end{aligned}$$

**Pythagorean Identities**

$$\begin{aligned} \sin^2(\theta) + \cos^2(\theta) &= 1 \\ \tan^2(\theta) + 1 &= \sec^2(\theta) \\ 1 + \cot^2(\theta) &= \csc^2(\theta) \\ \sin(\theta) &= \pm \sqrt{1 - \cos^2(\theta)} \\ \cos(\theta) &= \pm \sqrt{1 - \sin^2(\theta)} \end{aligned}$$

**Double-Angle Formulas**

$$\begin{aligned} \sin(2\theta) &= 2 \sin(\theta) \cos(\theta) \\ \cos(2\theta) &= \cos^2(\theta) - \sin^2(\theta) \\ \cos(2\theta) &= 2 \cos^2(\theta) - 1 \\ \cos(2\theta) &= 1 - 2 \sin^2(\theta) \\ \tan(2\theta) &= \frac{2 \tan(\theta)}{1 - \tan^2(\theta)} \end{aligned}$$

**Half-Angle Formulas**

$$\begin{aligned} \sin\left(\frac{\theta}{2}\right) &= \pm \sqrt{\frac{1 - \cos(\theta)}{2}} \\ \cos\left(\frac{\theta}{2}\right) &= \pm \sqrt{\frac{1 + \cos(\theta)}{2}} \\ \tan\left(\frac{\theta}{2}\right) &= \frac{1 - \cos(\theta)}{\sin(\theta)} \\ \tan\left(\frac{\theta}{2}\right) &= \frac{\sin(\theta)}{1 + \cos(\theta)} \end{aligned}$$

**Sum and Difference Formulas**

$$\begin{aligned} \sin(A + B) &= \sin(A) \cos(B) + \cos(A) \sin(B) \\ \sin(A - B) &= \sin(A) \cos(B) - \cos(A) \sin(B) \\ \cos(A + B) &= \cos(A) \cos(B) - \sin(A) \sin(B) \\ \cos(A - B) &= \cos(A) \cos(B) + \sin(A) \sin(B) \\ \tan(A + B) &= \frac{\tan(A) + \tan(B)}{1 - \tan(A) \tan(B)} \\ \tan(A - B) &= \frac{\tan(A) - \tan(B)}{1 + \tan(A) \tan(B)} \end{aligned}$$

### Product-to-Sum Formulas

$$\sin(A) \sin(B) = \frac{1}{2} [\cos(A - B) - \cos(A + B)]$$

$$\cos(A) \cos(B) = \frac{1}{2} [\cos(A - B) + \cos(A + B)]$$

$$\sin(A) \cos(B) = \frac{1}{2} [\sin(A - B) + \sin(A + B)]$$

### Sum-to-Product Formulas

$$\sin(A) + \sin(B) = 2 \sin\left(\frac{A + B}{2}\right) \cos\left(\frac{A - B}{2}\right)$$

$$\sin(A) - \sin(B) = 2 \cos\left(\frac{A + B}{2}\right) \sin\left(\frac{A - B}{2}\right)$$

$$\cos(A) + \cos(B) = 2 \cos\left(\frac{A + B}{2}\right) \cos\left(\frac{A - B}{2}\right)$$

$$\cos(A) - \cos(B) = -2 \sin\left(\frac{A + B}{2}\right) \sin\left(\frac{A - B}{2}\right)$$

### Power Reducing Formulas

$$\sin^2(\theta) = \frac{1 - \cos(2\theta)}{2}$$

$$\cos^2(\theta) = \frac{1 + \cos(2\theta)}{2}$$

$$\tan^2(\theta) = \frac{1 - \cos(2\theta)}{1 + \cos(2\theta)}$$

### Even and Odd Trig Functions

$\sin(-\theta) = -\sin(\theta)$	sine is ODD
$\csc(-\theta) = -\csc(\theta)$	cosecant is ODD
$\tan(-\theta) = -\tan(\theta)$	tangent is ODD
$\cot(-\theta) = -\cot(\theta)$	cotangent is ODD
$\cos(-\theta) = \cos(\theta)$	cosine is EVEN
$\sec(-\theta) = \sec(\theta)$	secant is EVEN

### Cofunction formulas(in degrees)

$$\sin(\theta) = \cos(90^\circ - \theta)$$

$$\cos(\theta) = \sin(90^\circ - \theta)$$

$$\tan(\theta) = \cot(90^\circ - \theta)$$

$$\cot(\theta) = \tan(90^\circ - \theta)$$

$$\sec(\theta) = \csc(90^\circ - \theta)$$

$$\csc(\theta) = \sec(90^\circ - \theta)$$

### Cofunction formulas(in radians)

$$\sin(\theta) = \cos\left(\frac{\pi}{2} - \theta\right)$$

$$\cos(\theta) = \sin\left(\frac{\pi}{2} - \theta\right)$$

$$\tan(\theta) = \cot\left(\frac{\pi}{2} - \theta\right)$$

$$\cot(\theta) = \tan\left(\frac{\pi}{2} - \theta\right)$$

$$\sec(\theta) = \csc\left(\frac{\pi}{2} - \theta\right)$$

$$\csc(\theta) = \sec\left(\frac{\pi}{2} - \theta\right)$$

### Derivative formulas (Calculus)

$$\frac{d}{dx}(\sin(x)) = \cos(x)$$

$$\frac{d}{dx}(\cos(x)) = -\sin(x)$$

$$\frac{d}{dx}(\tan(x)) = \sec^2(x)$$

$$\frac{d}{dx}(\cot(x)) = -\csc^2(x)$$

$$\frac{d}{dx}(\sec(x)) = \sec(x) \tan(x)$$

$$\frac{d}{dx}(\csc(x)) = -\csc(x) \cot(x)$$